

MOBILE SATELLITE SERVICE FOR CANADA

DAVID SWARD, Satellite Services Planning and Development, Telesat Canada

TELESAT CANADA
333 River Road
Vanier, Ontario
K1L 8B9
Canada

ABSTRACT

Canada has a market in search of a technology. The communications needs of industry, governments, and individuals have forced the development of unique technological solutions to overcome geographical and environmental barriers. A mobile satellite system is a key element in extending voice and data telecommunications to all Canadians. In order to realize this goal, the Federal Government and Telesat Canada have developed the MSAT system and made substantive commitments towards its implementation. This paper describes the MSAT system and a special program designed to provide interim mobile satellite services (IMSS) during the construction phase of MSAT.

INTRODUCTION

Pressures on business for improved productivity as well as growing demands for public safety services have resulted in a requirement for improved mobile communications with respect to coverage, reliability, and capacity. To date, the communications industry has responded to this need through the deployment of many separate terrestrially-based mobile communications networks. These networks, for economic reasons, are largely concentrated in and around urban centers and along major transportation corridors. Mobile communications satellites offer the opportunity to cost-effectively extend mobile services into rural and remote areas, thus paralleling the initial mission of fixed satellites in the early and mid-1970's.

Mobile communications satellites are not new from a technological standpoint. In addition to the international maritime mobile satellite system operated by INMARSAT, there have been numerous military and experimental mobile satellites launched since the early 1970's. The increasing importance and expanding market demand for extended mobile communications however has now developed to the point in North America that domestic mobile satellite systems can be seriously contemplated and supported on a stand-alone commercial basis.

With the introduction of the Canadian domestic mobile satellite service (MSAT) in the early 1990's, Canadians will enjoy the benefits of a truly ubiquitous mobile communications service encompassing land marine and aeronautical applications. Such benefits could also be extended to the countries that may never be able to justify their own dedicated system through the use of existing international mobile satellite authorities. Through effective co-operation between both international and domestic operators the benefits offered by mobile satellites can be expanded to all with interest in exploiting this technology.

SYSTEM DESCRIPTION

The current MSAT system concept consists of two satellites, one Canadian and one American, scheduled for launch in early 1992. The satellites are to be located in geostationary orbit at a nominal longitude of between 106° and 113° West. Each satellite will have the capability to provide back-up services to the other in case of satellite malfunction, as well as provide services to mobile users who move from one country to another. Figure 1 shows a typical Canada/U.S. co-operative system configuration.

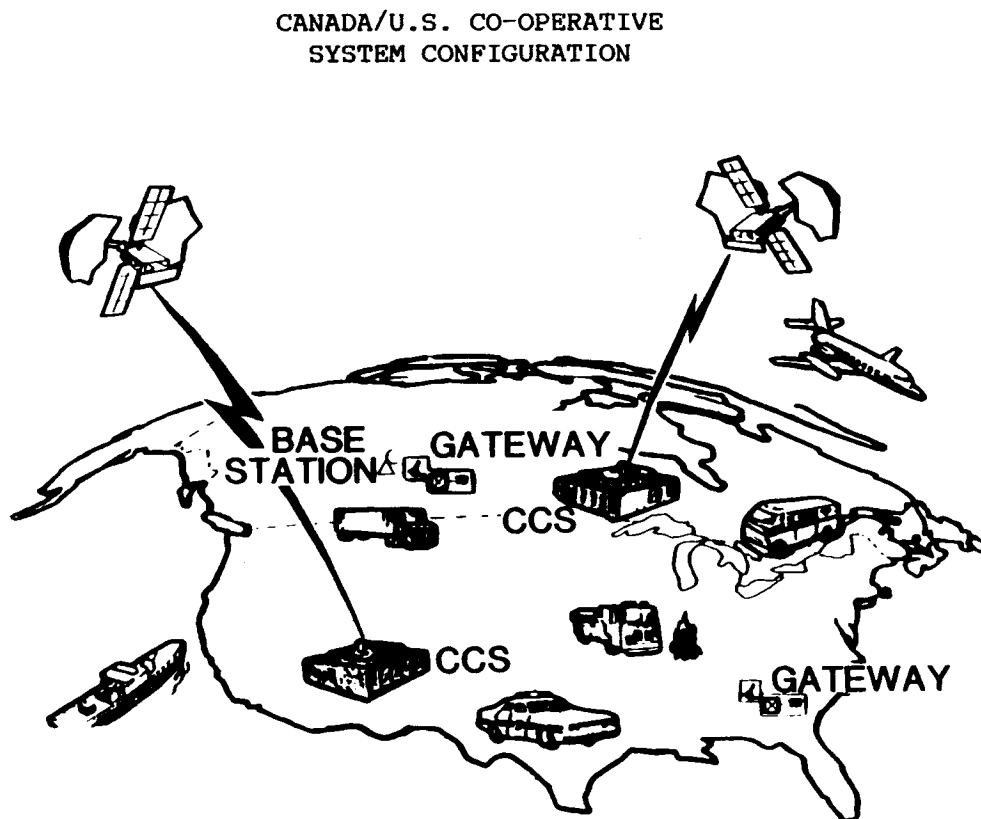


Figure 1 - Mobile Satellite Systems Serving Canada and the U.S.

At the recent World Administrative Radio Conference (WARC '87), 4 + 4 MHz in the bands 1555 - 1559 MHz (downlink) and 1656.5 - 1660.5 MHz (uplink) were allocated to land mobile satellite service (LMSS) on a primary, exclusive basis (except for 0.5 MHz from 1660 - 1660.5 that is shared with Radio Astronomy). Another 3 + 3 MHz in the bands 1530 - 1533 MHz and 1631.5 - 1634.5 MHz were allocated to LMSS on a co-primary basis. In addition, the frequency bands 1533 - 1544 MHz (downlink) and 1634.5 - 1645.5 (uplink) were allocated for low rate data LMSS on a secondary basis. The band 1626.5 - 1631.5 was also allocated for uplinking of low rate data in the LMSS on a secondary basis.

The current MSAT system is designed to operate primarily in the L-Band-to-SHF mode. All communications in the MSAT system will be linked through SHF Ku-band earth stations to user facilities. In other words, the communication between the satellite and fixed stations will use SHF Ku-band frequencies while the satellite-to-mobile communication will use the L-Band frequencies. This use of the SHF frequencies and SHF earth stations to provide such connections to user facilities economizes on the use of scarce L-Band frequencies and satellite power. The mobile-to-mobile terminal communications will be provided on a double-hop basis through the Network Control Center. Studies indicate that there is a limited requirement for such communications.

The base stations will provide interfaces for private mobile circuit switched services, such as voice dispatch systems. The gateway stations will provide direct connection to the PSTN (public switched telephone network) for mobile telephone service. The data hub stations will provide mobile packet switched data services with interconnections to terrestrial private and public data networks for applications such as vehicle locations and digital messaging to mobiles. These fixed stations will operate in the SHF frequency band. Although the specific SHF frequencies have not been formally specified, the current candidate bands include 14/12 GHz and 13/11 GHz frequencies. A diagrammatic representation of the system configuration is given in Figure 2.

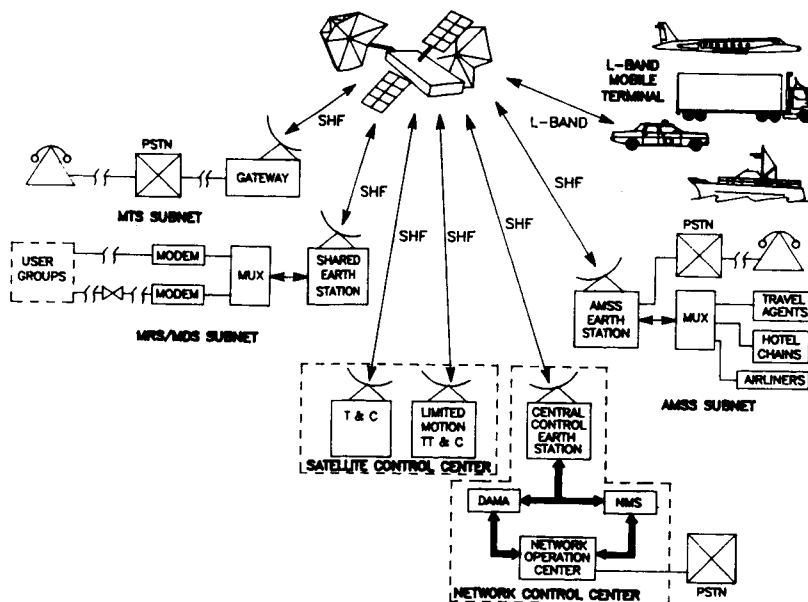


Figure 2 - MSAT System Configuration

In the present baseline design of the MSAT system, each satellite will have two large (a minimum of 5m in diameter) L-Band deployable parabolic reflectors which will generate nine beams covering Canada and the United States. Two additional beams may be incorporated to provide a capability for MSS within Mexico. Figure 3 shows the 9-beam coverage. Note that the design of the beams allows each satellite to service both Canada and the U.S. in the event that system restoration is required because of failure of either satellite.

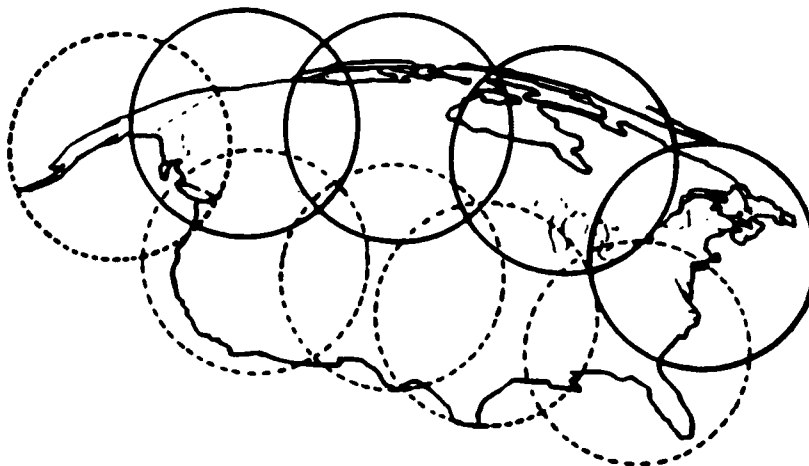


Figure 3 - 9-Beam L-Band Coverage of Canada and the U.S.

Because of the limited availability of spectrum in the L-Band, communication via MSAT will be established using 5 KHz channels as compared to the wider 30 KHz channels typically used in terrestrial systems. The satellite channels will be allocated to individual users on a demand assignment basis using a trunking concept, thus allowing the system to provide service to a large number of light-duty users. The demand assignment system (DAMA) and the network management system (NMS), will administer the communications capacity of the MSAT system and record airtime usage for billing purposes.

The speech modulation/coding techniques employed in the MSAT systems are constrained by the 5 KHz channel bandwidth. Two candidate modulation schemes currently under consideration and development are Amplitude Companded Single Sideband (an analog technique) and Differential Minimum Shift Keying with Pitch-Excited Linear Predictive Coding (LPC), (a digital technique).

The ground terminals which will constitute the ground segment of the first generation MSAT system fall into the following categories:

- (i) full and half-duplex mobile radio terminals;
- (ii) portable, transportable terminals;
- (iii) mobile data terminals;
- (iv) SHF base stations;
- (v) SHF gateway stations and finally;
- (vi) Network Control Stations (NCS) which will include the Network Management System (NMS) and the DAMA Control System (DCS).

The NCS base stations and gateway stations are fixed facilities and will employ highly conventional SHF parabolic antennas. The mobile units, and to a somewhat lesser extent, transportable terminals will employ relatively wide beam antennas with low gain in the 4 dBi to 12 dBi range.

SERVICE DESCRIPTION

MSAT will be used primarily in rural and remote regions where its wide-area coverage and extended range features are of greatest benefit. The MSAT system will provide a wide variety of telecommunication services such as voice, message and data communication to land vehicles, ships or aircraft. Some of the applications can be found in the following market sectors:

- trucking
- forestry
- coastal and inland shipping
- national paging
- remote monitoring and control of utilities
- mineral exploration
- law enforcement
- light aircraft communications
- environmental sensing
- emergency relief

Services offered initially on MSAT include mobile radio, mobile data, wide-area paging, supervisory control and data collection. A position location service will also be offered as a value-added feature. An analysis of the markets for MSAT services has indicated that 120,000 MSAT mobile units will be in operation by the turn of the century. 30% of these will be used for mobile radio applications and 70% for mobile data service. Recent studies of the demand for digital messaging/data services indicate that such data services may reduce demand for voice services in the future. For many applications, data transmission to text display terminals is equally effective as voice communications and offers additional benefits in terms of improved transmission efficiency, privacy, and cost.

Typical User Costs

An analysis of the MSAT system and market factors indicates that user costs would be as given in Table 1.

Table 1

Estimated MSAT User Costs excluding Terminal Equipment

Access Charges (per month/terminal)	\$50
Transmission Charges	
- Voice	\$1.50/minute
- Data	\$0.25 to \$ 0.75 per one-way message (32 to 128 characters)

Institutional Arrangements

In order to capitalize on the MSAT opportunity, Telesat has established a subsidiary organization called Telesat Mobile Incorporated (TMI). This subsidiary will furnish the necessary marketing, sales and service functions to provide mobile satellite services. The following diagram depicts the associated institutional arrangements.

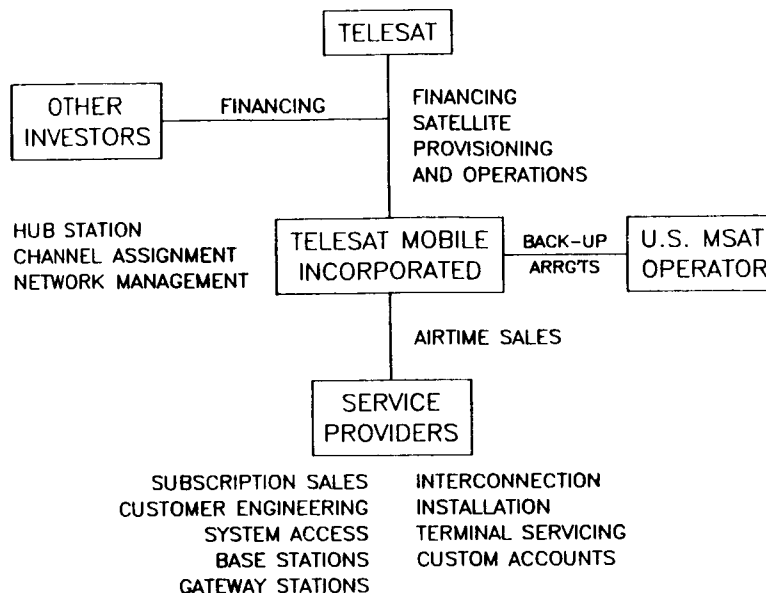


Figure 4 - The Corporate Structure for MSAT Services

Telesat will be the major shareholder of its subsidiary, Telesat Mobile Inc., with the remaining equity being held by other investors. TMI will own and operate the central control station and a network of base and gateway stations. It will contract with Telesat for the engineering expertise required for procuring and launching the satellite, as well as its technical operation in orbit. TMI will also be responsible for making a provision for back-up service with the U.S. mobile satellite operator.

TMI will engage in sales to end-users, private system operators, and independent value-added service providers. The service providers could include radio common carriers, telephone companies and large private mobile radio operations. All three groups operate terrestrial mobile communications systems today and MSAT would be a logical extension of this business. In addition, MSAT lends itself to the emergence of new entrepreneurial groups of service providers as only a small investment in base station equipment is required to provide MSAT services. Through business arrangements with both, traditional and new service providers, TMI will establish and manage a national distribution network for sales and customer service. For certain MSAT services and in areas where satisfactory agreements cannot be obtained with service providers, TMI may undertake to deal with end-users directly.

INTERIM MOBILE SATELLITE SERVICES

Although considerable momentum and commitment is building towards an eventual MSAT program, there remains a significant period of time, i.e. four to five years before MSAT will be in service. Today, amongst various industry and government sectors, there exists an immediate need for the types of services that only mobile satellite technology can deliver.

To meet this need, Telesat, in co-operation with Federal and Provincial Governments, and specific user groups, is developing a small portfolio of mobile satellite services using interim facilities.

Specifically, Telesat is working on two initial service offerings. The first is a trial of voice communications services to the Ontario Air Ambulance service. This program is sponsored by the Ontario Provincial Government with technical support from the Research Center of the Department of Communications. The objective is to provide two-way voice communications between hospitals and paramedics aboard air ambulances. This service is currently being tested over the INMARSAT MARECS satellite. Upon successful completion of trials, additional aircraft will be equipped and Telesat will endeavour to arrange for ongoing commercial service.

The second service offering under development is a data collection and two-way messaging service designed to meet the needs of the transportation industry. This service will allow fleet dispatchers to have continuous updates of location information from each vehicle in the fleet as well as the flexibility of transmitting and receiving 16 to 40 character messages. This program has several participants including the Ontario Ministry of Transportation and Communications, Federal Department of Communications, and representatives from the trucking industry.

It is planned to test this system over the INMARSAT MARECS satellite during the summer and fall of 1988 followed with commercial service in late 1989. Initially, the system will have a capacity of up to 6,000 vehicles. However, if additional INMARSAT capacity is available then, it will be possible to expand this service until such time as MSAT is available. Figure 3 depicts the operation of the proposed service to the transportation industry. Telesat has registered the name FLEET*STARTM to be used for this initial offering.

CONCLUSIONS

The Canadian MSAT system is a major component in a larger plan to provide mobile satellite services to all of North America. To achieve this, MSAT will be implemented in conjunction with a similar U.S. system in order to provide back-up and reduce development costs. MSAT will offer a full range of mobile telecommunications services including radio dispatch, digital messaging and data transfer.

In order to develop MSAT markets and technology prior to the launch of the dedicated system in 1992, Telesat plans to offer a limited portfolio of mobile satellite services using leased L-Band facilities. IMSS services will include two-way digital messaging, vehicle location, and voice services to high-need segments of market.

Telesat, through its MSAT and IMSS activities is preparing to enter the next domain of commercial satellite communications - mobile satellite services.